

591.9773

F74b

cop. 3

UNIVERSITY OF
ILLINOIS LIBRARY
AT URBANA-CHAMPAIGN
BOOKSTACKS



Digitized by the Internet Archive
in 2018 with funding from
University of Illinois Urbana-Champaign

<https://archive.org/details/biologicalinvest00forb>

1.9773
74 b
sp. 3

THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

ILLINOIS STATE LABORATORY

OF

NATURAL HISTORY

URBANA, ILLINOIS, U. S. A.

STEPHEN A. FORBES, PH.D., LL.D.,
DIRECTOR

BIOLOGICAL INVESTIGATIONS ON THE ILLINOIS RIVER

1. THE WORK OF THE ILLINOIS BIOLOGICAL STATION
2. THE INVESTIGATION OF A RIVER SYSTEM IN THE
INTEREST OF ITS FISHERIES

BY

STEPHEN A. FORBES

1910

The person charging this material is responsible for its return to the library from which it was withdrawn on or before the **Latest Date** stamped below.

Theft, mutilation, and underlining of books are reasons for disciplinary action and may result in dismissal from the University.

UNIVERSITY OF ILLINOIS LIBRARY AT URBANA-CHAMPAIGN

SEP 17 1977
OCT 4 1977

THE WORK OF THE ILLINOIS BIOLOGICAL STATION.*

Under the conviction that the present movement for an intensive, scientific study of local faunas and floras is likely to grow, and to dominate largely the work of many of our younger biologists, and that it will center at first in our universities, but will come to require more or less independent biological stations for its complete realization, I have thought that an outline of the efforts of a few Illinois naturalists to work this field in a systematic manner might be of interest and of advantage, both positive and negative, to the members of this Society.

The establishment, on the Illinois river sixteen years ago, of a small station devoted to this end was immediately owing to the coincidence of a circumstance and an accident, the circumstance being the existence of a natural history survey of the state, in rather slow and desultory operation at the time, and the accident being the shifting of certain courses in zoology at the University of Illinois from one year to another in such a way as to leave the department with much less than the usual amount of teaching to do during the year 1894, and with much more time, consequently, for outside work. In view of these conditions and others which it is not necessary to specify, I asked of the trustees of the University, in March, 1894, an appropriation of fifteen hundred dollars a year, and a further sum of five hundred dollars, to enable me to establish on the Illinois river a permanent biological station for continuous investigation work throughout the year; and in partial compliance with this request, a sum of eighteen hundred dollars was made available for the purpose. Two weeks after this vote, a station was actually opened at Havana in leased quarters, with a temporary equipment provided by the natural history survey and the University conjointly. As the university appropriation was not available until the first of July, the funds of the natural history survey were drawn upon for the establishment of the work and for its maintenance for the first three months, and the same source of supply was resorted to to meet all deficits on station account up to July 1, 1895. At the biennial legislative session of 1895 the Illinois legislature made an appropriation of twenty-five hundred dollars for the equipment of the Illinois Bio-

*Read to the Central Branch of the American Society of Zoologists at Iowa City, April 8, 1910.

logical Station (under that designation), and of three thousand dollars per annum for its expenses. This legislative appropriation for expenses was repeated in 1897 in a bill providing for the maintenance of the natural history survey, and the work has been continued under these auspices, and with approximately these appropriations, ever since. The station is consequently a state establishment, supported wholly from state appropriations, for purposes of investigation only,—a point in which it differs, I think, from every other American station of aquatic biology.

Its general objects, as defined by me in a formal report published in 1894, were to provide additional facilities and resources for the natural history survey of the state; and to contribute to a scientific knowledge of the whole system of life existing in the waters of the state, with a view to economic as well as to educational applications. It had for its immediate field the entire system of life in the Illinois river and connected lakes and other adjacent waters; and an intention was expressed to extend operations as rapidly as possible to the Mississippi river system, thus making a beginning on a comprehensive work on the general subject of the aquatic life of the Mississippi valley in all its relations, scientific and economic.

The special subject upon which I fixed at first as the point towards which our studies should tend, was the effect produced on aquatic plant and animal life by the periodical overflow and gradual recession of the waters of great rivers,—a topic chosen especially because it had never been studied, and because it included in its scope nearly everything concerning the life of our waters of any considerable interest either to the biologist or to the practical man. As another result of our work I hoped that we should accumulate material for a comparison of the chemical and biological conditions of the waters of the Illinois river at that time and after the opening of the Chicago drainage canal, then in process of construction.

The main features of the equipment provided, were a floating biological laboratory, built especially for the purpose in 1895, a steam launch, a number of skiffs, a variety of seines, pound-nets, dip-nets, and other fishing apparatus, a plankton equipment, including a centrifuge for the rapid condensation of the minute contents of the collections, and a set of breeding-cages of special construction for keeping aquatic insects under natural conditions but exposed to continuous observation. The laboratory boat was amply provided with microscopes, chemicals, glassware, aquaria, and apparatus and ma-

terials for the preservation of specimens and for ordinary microscopic technic. It was equipped with tables and other essentials for fifteen workers in addition to the station staff. It proved to be admirably adapted to its objects, being as comfortable and satisfactory a workroom for the investigator as were the regular laboratories of the University. It had, for our purposes, the very great advantage of a thoroughly portable character, and it was repeatedly moved from place to place at Havana, and established for months at a time at various other points on the river.

Beginning in April, 1894, the work continued at Havana until April, 1899 (five years), at which time it was transferred to Meredosia, about forty-five miles down the Illinois. Here it remained until June, 1901 (two years and two months), when it was moved up the Illinois a hundred and sixty-five miles to Ottawa, the highest point on the river which it was possible to reach with our equipment. After a year and five months at Ottawa, the station equipment was transferred early in November, 1902, to Peoria for the winter, and in May, 1903, it was removed to Henry, thirty-three miles above.

After the organization of the Station, the survey of its field, and the selection of substations for continuous work, it remained in charge of Professor Frank Smith for the first fifteen months, after which Dr. C. A. Kofoid was made its superintendent. Resigning to take effect December 31, 1900, Dr. Kofoid was succeeded by Mr. Thomas Large, who was in charge until the fall of 1902, and he was followed by Mr. R. E. Richardson in 1903.

By the fall of 1903, after more than nine years of active operation, our accumulations had so far outrun our systematic studies that a change of program was imperative; and the equipment was laid up at Henry under a caretaker, where it remained out of use, except as loaned to the Chicago Drainage Commission, until the summer of 1909. You all remember the Lincoln story of the Sangamon river steamboat, which could make steam enough to run if it didn't whistle, but could only whistle by ceasing to run. Our biological station has found itself, from time to time, in a similar predicament. It has not had money enough to maintain active operations in the field and to prepare and publish papers and reports at the same time. So, after a nine years' run, it began to whistle, and now, having blown its three long blasts—two on the plankton collections and one on the fishes of the state—it has been running again since last July.

The field work of the first two years was comprehensive of all aquatic forms and situations, including plankton collections, quantitative as well as qualitative, shore and marginal collections of mollusks, insects, and crustaceans, dredgings from the bottom at various depths, and collections of fishes and other vertebrates, by means of various kinds of apparatus. The next three years were mainly devoted to plankton work in the Havana district, and the last four, spent mainly at Meredosia, Ottawa, and Henry, to work on the fishes of the Illinois system. During our period of active operation, approximately six thousand collections were made in all, of which five hundred were fishes and two thousand were plankton collections, the remaining thirty-five hundred consisting of insects, mollusks, and a general variety of aquatic and subaquatic forms. Six hundred and forty of the plankton collections were made at Havana by strict quantitative methods, and were thus available for a comparative study of the product of various waters at all times of the year. Two hundred and thirty-five of these were from the main stream and four hundred and five from other stations adjacent.

Besides our purely biological work, weekly samples of waters were regularly examined by chemical methods for three and a half years, under an arrangement with the Water Survey of the state, established in 1895.

I can not attempt, in this rapid outline, to present even in briefest summary the results of this work, but may be permitted to abstract a few general statements from its two most important publications—the report on the fishes of the state and that on the plankton collections, the former prepared by Mr. Richardson and myself, and the latter by Dr. Kofoed.

From our fish collections it appears that the Illinois basin is thoroughly representative of the state at large. Of the hundred and fifty species of Illinois fishes known to us, a hundred and twenty-eight occur in the Illinois or its tributaries. Of the twenty-three species not found by us in that basin, eight are excluded by their definitely southern range, six by their distinctly northern distribution, and four are as definitely western, while the five remaining are so rare in Illinois that they appear in any of our waters only by an unusual chance. About three dozen of the hundred and twenty-eight species in the Illinois basin have a marketable value as food. A dozen of the best species are of really good quality, and half of these are among the best freshwater fishes in the country.

From our plankton studies it appeared that the average ratio of plankton organisms to the water of the main stream, year in

and year out, was 2.7 parts per million, and the total average amount of plankton moving down stream past Havana reached the astounding aggregate of three hundred and fifty thousand barrels, or seventy-five thousand tons, per annum, equal to eight and a half tons per hour the year round. This was about fifteen times the total weight of the fish then taken from the river each year.

Besides our plankton studies made at the various Havana stations, each representative of a characteristic aquatic situation, a beginning has been made in a study of the system of the entire stream, taken as a single unit of environment. For this purpose, trips by steamboat were made for considerable distances, with continuous plankton collections throughout each trip. Longitudinal biological sections of the stream were thus made, aggregating four hundred and fifty miles for the Illinois river and three hundred and sixteen miles for the Mississippi, from St. Louis to Quincy and return. On the first trip, made in May, 1899, an iron pipe delivered a continuous stream of water into a plankton-net which was lifted and emptied every twelve miles. In all the other trips a steam pump was used to supply a continuous current, which was passed through a meter, enabling us to determine precisely the amount of water strained.

By such studies one gets a vivid idea of the individuality of the river as an organism, and of the complexity of its structure and the sensitiveness of its physiological reactions. A stream like the Illinois, with its flowing current, varying in rate in different parts of its course, variously fed by streams, by lakes, by marshes, and by underground springs, temporarily influenced and often profoundly affected by local storms, by drouth, by floods, is a very different subject of study from a lake, and to me a far more interesting one. A lake is sessile, simple, stolid, coelenterate; a river is motile, complex, sensitive, and articulate: a lake has an aspect, a constitution; but a river has a character, a behavior. The river has also a special attraction to the student of biology in that it is more readily analyzable than a lake, into distinct and largely independent sections or situations which can be studied separately and as a series.

For a discussion of our data of continuous collection, we have divided the Illinois from Hennepin to its mouth, the part patrolled by us, into six sections, each with its well-marked individuality. The slope of the bed, the extent and nature of the bottom-land waters feeding the main stream, the size, length, and number of its tributaries, and the contributions of sewage waste from towns upon

its banks, are the principal causes of differentiation in different parts of its course,—differences which express themselves most vividly in the amount and character of the plankton, but which are reflected also more or less definitely in the general aspect of its biology.

Since last July our work has been carried forward under the immediate charge of Mr. R. E. Richardson. It has been mainly directed to a comparison of present conditions with those of the period preceding the opening of the drainage canal, and to the collection of materials for a fuller study of the food of fishes than has hitherto been made and for a comparative study of the contents and the physical and chemical condition of the bottom in several selected situations, as related to differences in the plankton and other biological products. From weekly collections, begun August 20 and continued for four months, we learned that the yield of plankton in the main stream per cubic meter was then, at Havana, approximately double that of our earlier period, notwithstanding the fact that the water-level is about three feet higher on an average than it was before the opening of the drainage canal.

Our main objects for the coming two or three years will be to complete a comparison of present conditions with those of the former time; to study the river as a unit with reference particularly to its economic values, its protection, and its improvement; to work out the details of its biological regimen by a study of the influence of the various conditions affecting the course of events in various situations; and to carry out comparative studies between the Illinois, the Mississippi, and the Missouri—all readily accessible from our location and by means of our equipment. It is a large, a fruitful, and an important field of research, and we invite the cooperation of all so situated as to contribute to our knowledge of any part of it; and to this end investigators will be admitted to our Havana station at any time after June 1.

THE INVESTIGATION OF A RIVER SYSTEM IN THE INTEREST OF ITS FISHERIES.*

We have in Illinois a river of the same name as the state, which is in many ways one of the most remarkable streams in the country, and in no respect is it more remarkable than in its natural adaptation to the breeding and maintenance of a large and varied population of fishes and other useful aquatic animals; in none has it made a more remarkable record than in the supply of fish food which it has produced and is now producing—not for Illinois only, but for the country at large, sending out of the state, as it does, and mainly into eastern cities, much the largest part of its catch. The annual yield of the Illinois river in fishes only is over twenty-four million pounds, worth at wholesale about \$738,000. If this annual output were turned into silver dollars, and these were placed in a row, equidistant from each other, along one of the banks of the stream, there would be a dollar every year for every two feet of the river's course from its origin to its mouth.

Furthermore, we have no reason to suppose that this stream and its adjacent waters have yet reached their limit of economic yield. The effect produced on them by the opening of the drainage canal from Chicago, and the still greater effect due to the introduction of the European carp, are examples of the fact that the original condition of the stream may be largely changed for the better, and give us reason to believe that it may be made a still more important asset than now, both for the people of the state and for the general public who are the chief consumers of its product. Evidently this is one of the natural resources of the state and country which should be carefully safeguarded. A thoroughgoing, practical investigation of this stream is now especially imperative because of the great changes in progress at the present time in its environment and the still greater changes contemplated or impending, which have affected, or must certainly affect, greatly and permanently, its value for the purposes which it now serves. Reclamation projects, for the protection, drainage, and cultivation of its bottom-lands; manufacturing projects, threatening a various contamination of its waters; canalization projects and projects for the control and equalization of its flow, in the interests of transportation,—all are being earnestly agitated, and several of them are in process of active execution.

*Read before the American Fisheries Society, New York City, September 28, 1910.

Although the problem of the maintenance and development of favorable conditions in this stream is by these facts made somewhat special, in many of its general features the Illinois is virtually like all other rivers, and a satisfactory program for its investigation would be readily adaptable, I believe, to many other streams, and applicable in its main features to rivers in general. It is for these reasons especially that I have ventured to ask the attention of this broadly representative body to my special topic, and to ask your criticism of its proposals now, when criticism can be made most profitable.

Versed as you are in the literature and accepted methods of fish-culture, I scarcely need remind you that principles of management and methods of protection and improvement are not nearly so well settled for the fisheries of our natural waters as they are for fish-culture in artificial ponds, and that the maintenance and utilization of our fisheries has been much less thoroughly studied for rivers, either in this country or in the Old World, than it has for lakes. This is, no doubt, in part because lake fisheries are, generally speaking, both more important and more readily controllable than river fisheries, and partly because the river problem is much the more complicated and difficult of the two. The Illinois river has, however, so many lakes in its bottom-lands, merged with it in times of flood, distinguished from it successively with the retreat of the overflow, but connected with it and contributing to it at its lowest levels, and the river itself has, as a home for fishes, so many of the characteristics of a lake, that its problems, although complex and difficult, do not compare unfavorably in importance with those of any lake in the world of equal area. Its average fall through the lower four-fifths of its course is only $1\frac{2}{3}$ inches per mile, and there are stretches of several miles throughout which its fall per mile is only about a quarter of an inch. Its current at low water, as it swings from side to side of its broad and level flood-plain, is as slow, at the dams, as half a mile per hour, and although the mid-stream flow at high water is of course much stronger, there are even then extensive backwater shallows in which a fish could hardly tell whether it was swimming upstream or down.

It is one of the most interesting features of our field of operation that we are able to bring easily into comparison the system of life in this sluggish, lake-like stream with that of the swift Mississippi, into which it flows, or that of the still swifter Missouri, whose mouth is only twenty-four miles from its own. Even the Ohio, very

different physically and biologically from either of the other three, is not beyond our reach, and comparative studies of all these streams have been begun by us this year.*

In such an investigation as is here proposed, the foundation inquiry which must fix our beginning points and show where the principal emphasis should at first be placed, is this: Just what is it that we need to know in order that we may be in a position to do all that we might hope to accomplish, and ought to undertake, for the conservation and increase of our aquatic resources? To this inquiry I must make, at first, a general and perhaps a disappointing answer. It is perfectly evident that if we wish to maintain or to improve the conditions of life for the fishes of our rivers, we must first know what the present conditions are, and which of these are the most important to our purpose. We might, it is true, hatch young fish by the million, and throw them out by the hundred thousand, into all the sorts of waters which their species inhabit, without any precise knowledge on our part of the conditions in which they will find themselves when set free, or any rational judgment of the chance that they can survive to adult size. This sort of thing, I surmise, has sometimes been done, but I hope that it is, at any rate, done no longer, and certainly it can no longer be defended as either scientific or practical; it is simply ignorant. Intelligent plans for their improvement require that we should know the conditions under which our fishes live, and that we should be able to distinguish beneficial conditions from injurious, and important conditions from unimportant. We need to know what our fishes require in respect to the main essentials of their well-being—that is, to a suitable water supply, to oxygen for respiration, to temperature in the different parts of the year, to their food at all their ages, to breeding places, to freedom of migration and other necessary movements to and fro, and to freedom from injurious physical conditions, from poisonous gases and solutions, from parasites, from diseases, from excessive competition, especially for food, and from decimation by their enemies.

It is commonly conceded I think, both by scientific students and by practical fishermen, that the most general and rigorous limitations upon the numbers of fishes are those set by their breeding

*Plankton collections, continuous for all practical purposes, have now been made from the main streams of these great rivers, aggregating 1010 miles for the Illinois, 1195 miles for the Mississippi, and 46 miles for the Ohio. On the Illinois river these collections were made, for ninety miles, from the station launch; but for the remainder of this Illinois work, and for all that on the Mississippi and the Ohio, we have had the use of the steamer "Illinois," kindly placed at our disposal for this purpose by the State Fish Commission.

grounds and their food supply, and that of these the latter is the most important. We especially need to know, therefore, what the more valuable fishes feed upon as fry, as young, and when full grown, under various conditions, and at different times of the year; where their food supply is most abundant; whether their most important food resources are at all times sufficiently accessible to them, and under sufficiently favorable conditions; what their food species feed upon in turn; and so on down through the series of forms dependent one upon another until we reach the primary sources of their food, and the conditions of its greatest abundance and availability. Next we need to know, for each important fish, its spawning times and places; where such places are to be found; whether the fry can escape from them in due season, and if not, why not, and what can be done about it; whether such most desirable spawning grounds are present in the necessary abundance and of convenient access, and if not, what can be done about that. All this involves, as it seems to me, a systematic survey and description, from the fisheries standpoint, of the whole congeries of waters—main river, tributary streams, and connected lakes—so made as to lead to a clear discrimination of their individual features as homes for fishes or places of occasional resort, and leading also to a classification of them in definite groups and kinds, each kind containing similar waters with similar surroundings. As soon, however, as we attempt to analyze, in this sense, the environment and the needs of the more important fishes, we find the essential elements of their welfare so interwoven, in one direction or another, with those of virtually all the other organisms in their neighborhood, and determined at so many points and in so many ways by the whole local system of things—biological, chemical, and physical, aquatic and terrestrial, climatic and seasonal—that there is evidently no fit way to our end except by a general survey and analysis of that system as a whole.

My proposed program of investigation begins, consequently, with a general natural history survey of the river and its tributary waters,—with fishes, of course, in the lead, where they belong biologically as well as economically, since in them all the life of the waters culminates and centers. A great river system however, is a large and complicated unit to handle as one, and the Illinois with its two hundred and seventy miles of length and its basin of twenty-nine thousand square miles, proved to be too large a subject for us to study with equal attention to all its parts. Such a river system may, however, be readily analyzed into an assemblage of situations, each situation perhaps many times repeated in different parts of the area.

and a study of the river as a whole may be best organized and pursued at first as a study of these typical situations out of which the whole system is compounded. A large and varied group of such characteristic features, all readily accessible from a single center, was found at Havana, in the middle section of the Illinois basin, and in that section, consequently, much the greater part of our work on the river has hitherto been done. There we have gained, in the course of years, a fairly exhaustive knowledge of the fishes of all descriptions to be found in those waters, together with an approximate knowledge of the relative abundance of each in average years; a knowledge of the preferred haunts and usual range of the various species of fish, and some acquaintance with their annual migration movements; a mass of data concerning their associations one with another in the same situation and at the same time, and the competitions for food and other necessities which these associations express; a fair acquaintance with both the average and the exceptional food of many of the species, including most of the really important kinds; a considerable body of information concerning their breeding habits and their spawning times and places; an accurate knowledge of both the composition and the quantity of the plankton of our streams and lakes, obtained by several years of systematic collection, measurement, and enumeration; a fairly full acquaintance with the other animals and plants of the area—those which inhabit the margin, live on the bottom, or lie buried in the mud; and a considerable quantity of very interesting and really important material illustrating the effect on the whole system of life of the Illinois river produced by the opening of the Chicago drainage canal in 1900. We have also made many studies of the waters themselves in respect to their physical and chemical characteristics and peculiarities under varying conditions and at various seasons, and have begun similar studies of the mud and other materials of the bottoms of lakes and streams.

In this general field we now need merely to finish our studies along special lines, and to extend somewhat the geographical range of our detailed survey. We shall then be both ready and free to take up special problems of immediate economic interest. Indeed, much has already been done by us on such practical problems, as may be seen from a few illustrations.

We learned a good many years ago—and this fact was first established in Illinois—that virtually all our young fishes, whatever their adult habits may be, live at first on the same kind of food. All which hatch in like situations and at approximately the same time, consequently, compete with each other when they first begin to feed.

We have also learned that this first food—the minute plant and animal life of the water, called its plankton—is produced almost wholly in the backwaters. Although flowing streams often carry an enormous quantity of it, this mainly perishes presently in our great silt-laden rivers. When, as in very low water in midsummer, the contributions from the backwaters are reduced to a minimum, or perhaps wholly cut off, the plankton of the stream also falls off to little or nothing. Left to itself, indeed, even so slow a river as the Illinois would virtually empty itself of plankton in a little while. The fish-producing capacity of the stream is thus proportionate, other things being equal, to the extent and fertility of the backwaters accessible from it, and contributing to it at the hatching time of fishes. The plankton content of a stream at that time is, in fact, an excellent index to the productive capacity of the waters as a whole.

These facts have some interesting consequences, one of which is that every useless fish is an injurious one, since it competes for food, at least when young, with the useful kinds. By a useless fish, however, I must be understood to mean one which is both valueless to us and which does not contribute in any important way to the maintenance of valuable kinds.

There is a notable harmony between the time of highest flood in our great rivers, the spawning time of the bulk of our fishes, and the climax period in the development of the plankton. All coming together or following one another in quick succession, as they normally do, conditions are as favorable as possible for a large stock of young fishes. The longer the period and the larger the scale of the spring overflow, the better is the prospect for a heavy annual contribution to the population of the stream. To this no doubt is due the fact, clearly indicated by our recent river work, that the plankton product of the Illinois system has been greatly increased by the opening of the drainage canal from Lake Michigan and the consequent raising of the average level of the river by about three feet, this rise of river level of course resulting in a more wide-spread and longer-continued overflow.

On the other hand, nothing can be more dangerous to the continued productiveness of these waters than a shutting of the river into its main channel and the drainage of bottom-land lakes for agricultural purposes. It is fortunate for our fisheries when one of these lakes comes into the possession, or under the control, of a hunting or fishing club, for this insures its maintenance. The time has come,

in my judgment, when the state should consider seriously the policy of preserving adequate breeding grounds and feeding grounds for our river fishes, even if it has to acquire and maintain them, since these waters are in imminent danger otherwise of being practically depopulated.

It is another interesting conclusion from our recent work that the enormous outpouring of Chicago sewage into the upper Illinois improves rather than impairs its fitness for the maintenance of fishes. The organic wastes thus emptied into the stream are laid hold of by bacteria and *Protozoa*, and passed up by successive steps to form the flesh and bones of fishes, and thus finally those of men. The same may be said of the organic wastes of the towns along the banks of the stream.

Still another conclusion of considerable practical interest may be here mentioned, although it grew out of our aquatic work outside the Illinois basin. One large section of the state of Illinois, comprising about a fifth of its area, is peculiar in the absence, or at least in the unusual rarity there, of a considerable group of fishes which are abundant elsewhere in the state and elsewhere in the surrounding territory. Now this section, the conditions of which these fishes evidently do not tolerate, is distinguished from the remainder of the state by its geological history, and, as a consequence, by the different character of its soil and of its streams. The soil is so finely divided that its particles can not be wholly separated from the water, even by repeated filtering with the finest filter papers, and it thus remains persistently and perpetually turbid. The fishes which seem to avoid this situation are, on the whole, those which we find in other parts of the state to be relatively infrequent in very muddy water. The inference is plain that it is the permanently muddy character of these southern Illinois streams, itself due to the geographical history of the district, which renders them unfit for these more sensitive fishes. Any attempt, consequently, to increase the number of such fishes there would be foredoomed to failure. Doubtless there are many other instances of the same sort to be found in other parts of the country, and it seems possible that various mysterious failures of attempts made to introduce new fishes are attributable to some such cause, not taken into account because unknown.

We have now a long waiting list of special practical inquiries which seem clamoring to be made. We need, for example, to observe most carefully the European carp, now undergoing enormous multiplication in our interior waters; to learn the details and the

variations of its food and its habits under different conditions; to study the bearings and consequences of its spread and increase on the welfare of our native fishes, and on the whole system of fresh-water life; to watch for evidences of local over-population by it, to be suspected when the carp or its competing species fall below the average in size and plumpness, or when epidemic diseases appear among them; to follow the course of events in its principal spawning grounds, where our own observations show that tremendous losses, amounting to a local extermination of the young, may occur under usual conditions; and to determine, by the use of numbered tags, the range of the wanderings of this and other fishes, and especially to learn how far the various species usually go from the places where they were hatched. We have a rare and remarkable opportunity in Illinois to watch the progress of a biological revolution as important to the life of our waters as was the Norman invasion to the life and history of England. Fortunately, we have for comparison with present and future conditions, the materials and records of several years' systematic and connected work done on the Illinois river before the opening of the drainage canal into Lake Michigan, and when the carp was but just beginning to make its presence felt as a disturber of the then existing order.

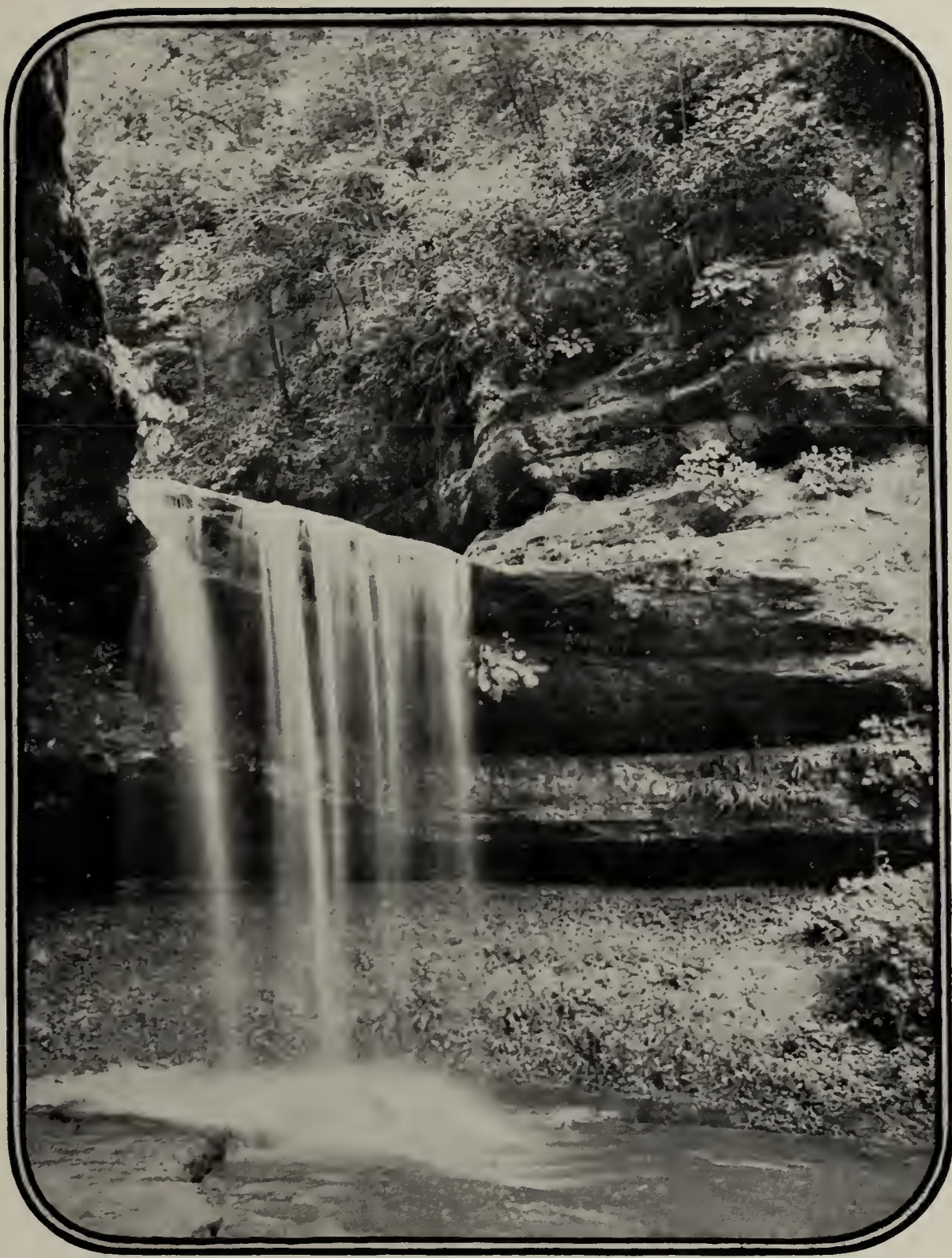
I can not, within the time limits of your program, go further with the development of this subject, and I must content myself with these sample fragments of its discussion. When the results of our river work began to appear several years ago, a leading American zoologist wrote me that the Illinois promised to become very soon the best known—because the best studied—of any river in the world, and we have been at work a good deal of the time since in an effort to increase still further our knowledge of that stream and the public appreciation of its value. In the face of the gigantic interests—agricultural, industrial, commercial, and political—which are now mustering along its course, with huge schemes in hand for revolutionary operations upon its channel, its banks, and its backwaters, we feel that we need all the backing and assistance we can secure from those concerned in the preservation and development of our native fisheries; and no agency, I am sure, is in a position to give us more effective aid than this old and influential American Fisheries Society. Especially we shall value your suggestions both as to subjects deserving early investigation, and also as to practical measures possible and desirable on the basis of such knowledge as we now have or may presently acquire.



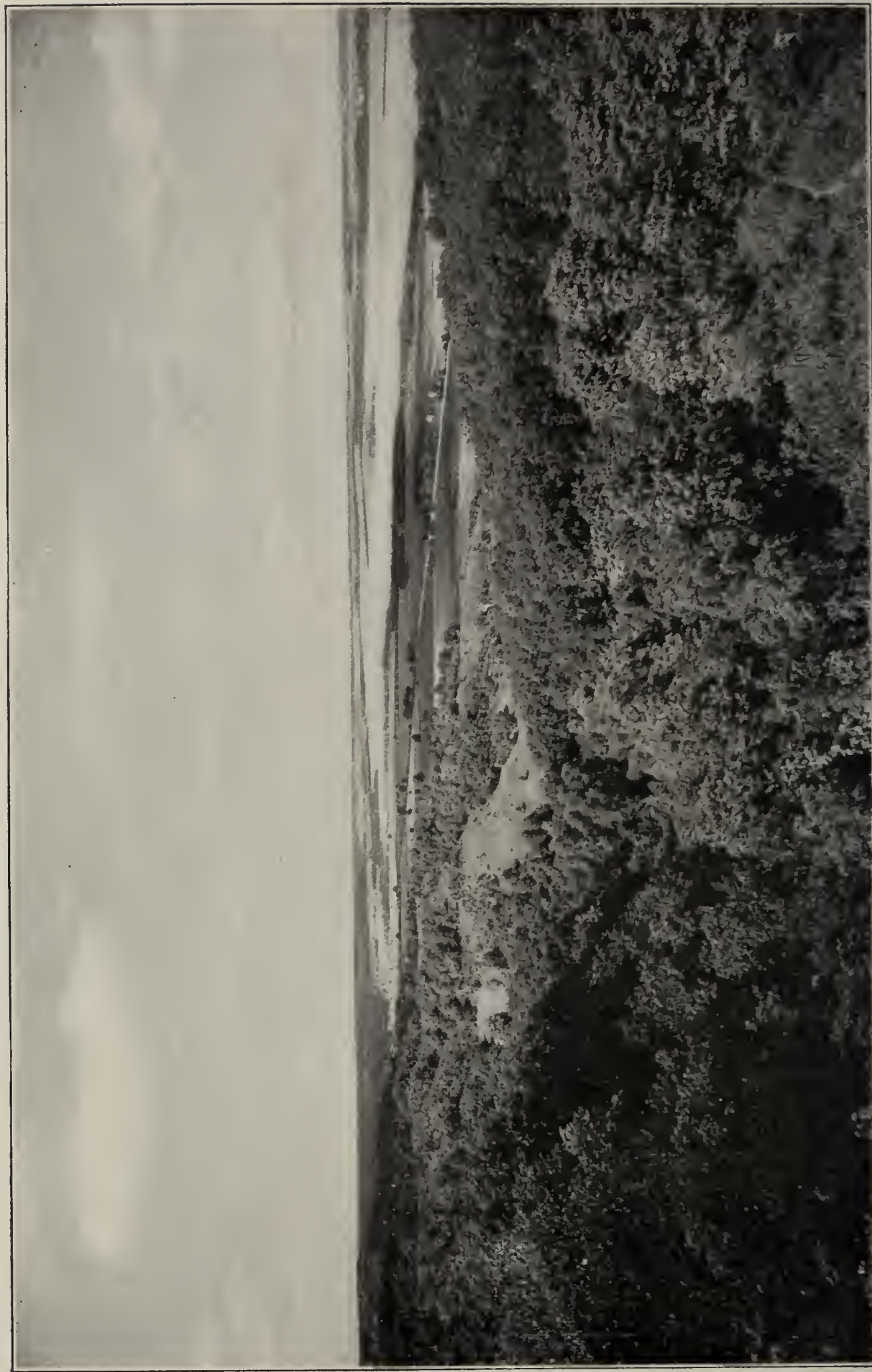
The Illinois River from Havana, 1910. Entrance of Spoon River (beyond steamboat); Thompson's Lake and Flag Lake in the distance; western bluff in the background.



The valley of the Illinois from Starved Rock, near Ottawa, Ill.



In Horse-shoe Cañon, near Ottawa, Ill.



The valley of the Illinois from Prospect Heights, above Peoria, Ill.



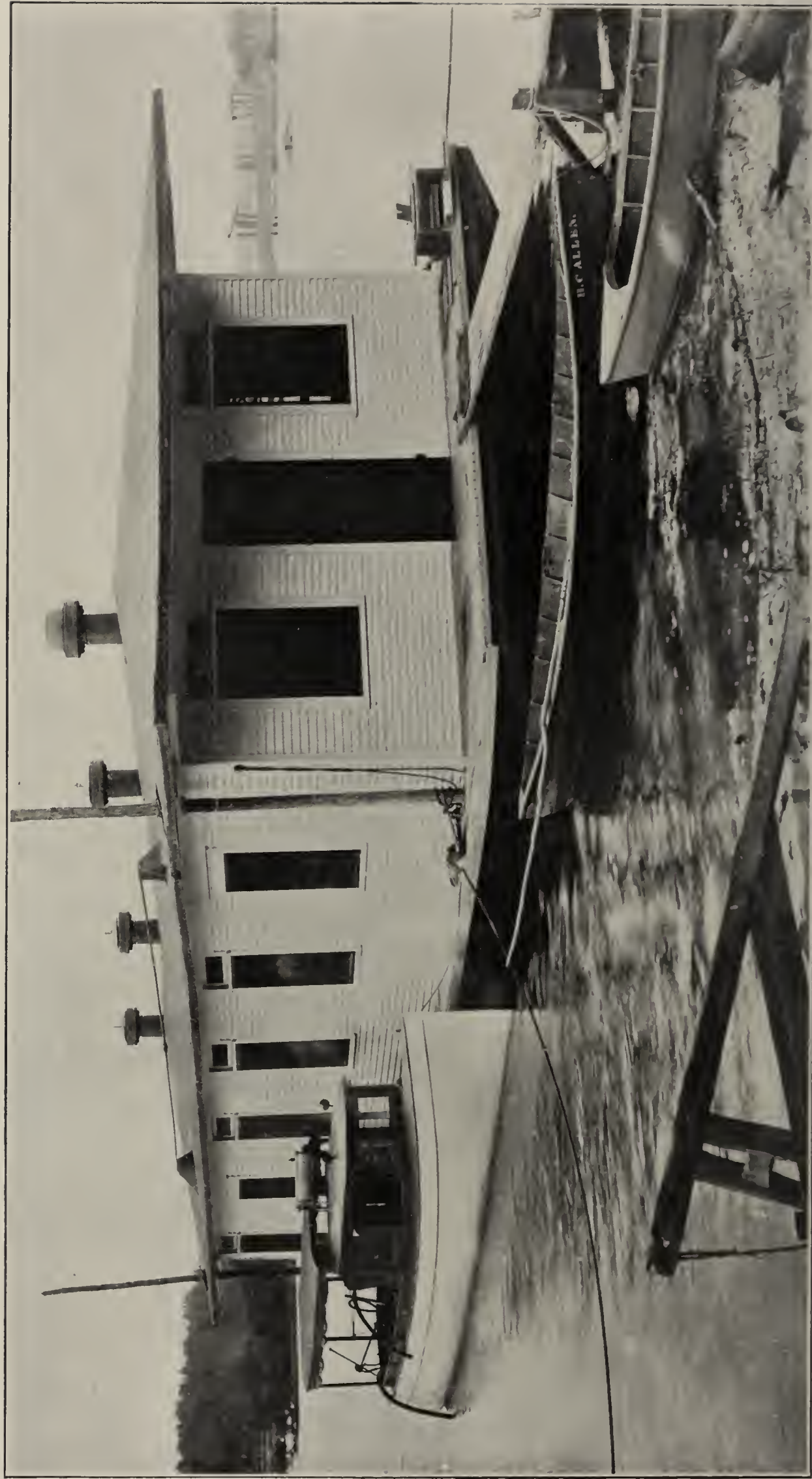
Characteristic views from the middle course of the Illinois River.



Permanent overflow of Illinois River bottoms. In "cut road"
leading into Thompson's Lake.



View of Flag Lake, 1910.



Laboratory-boat and station launch.



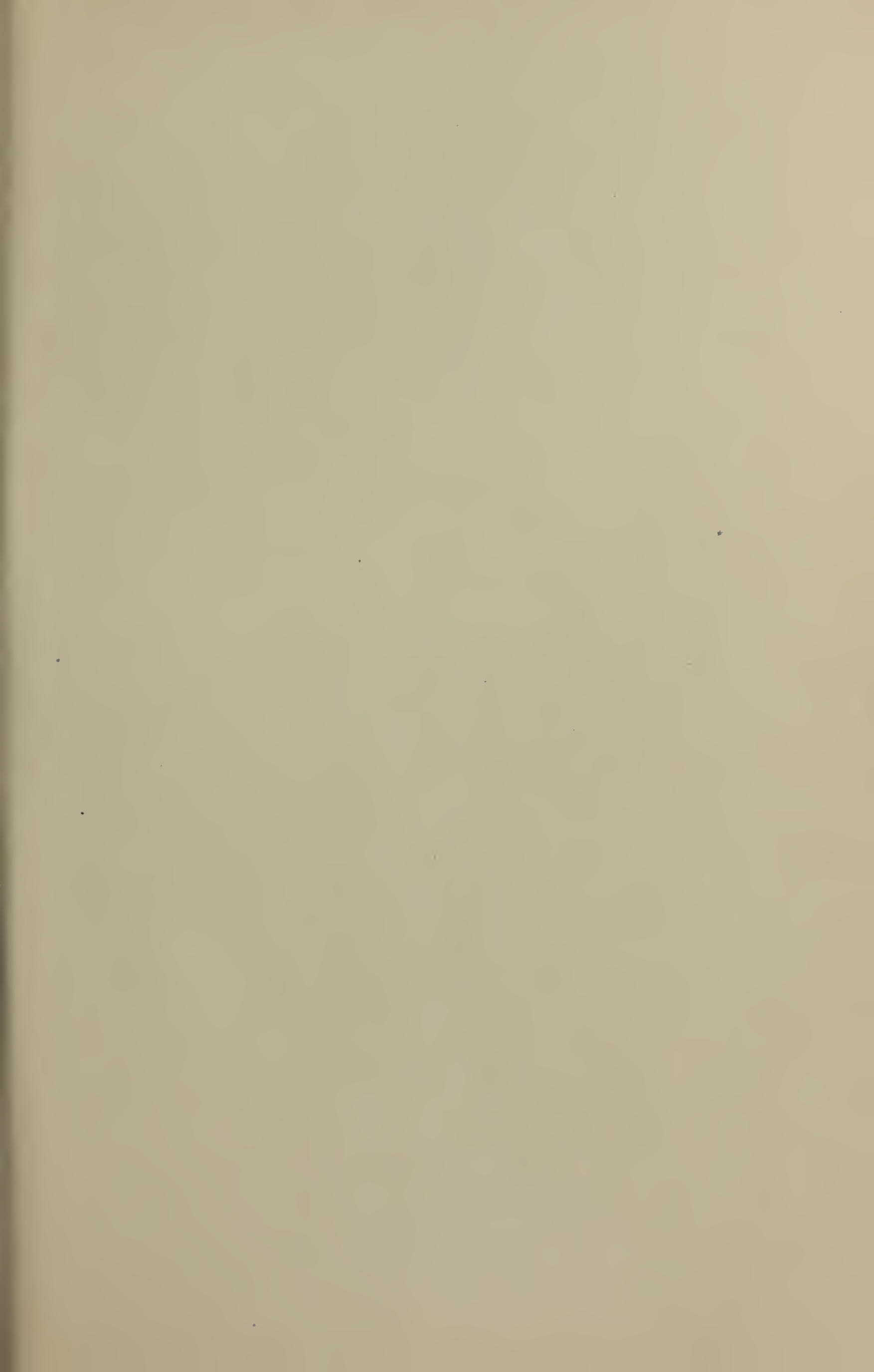
On the breeding grounds, watching movements of fish, and searching for fish nests and fry.



Mud-borer and equipment for collecting and assorting materials of bottom.



Preserving a plankton catch, in station launch. (Richardson, *naturalist*; Allen, *fisherman and engineer*.)



UNIVERSITY OF ILLINOIS-URBANA



3 0112 068175659